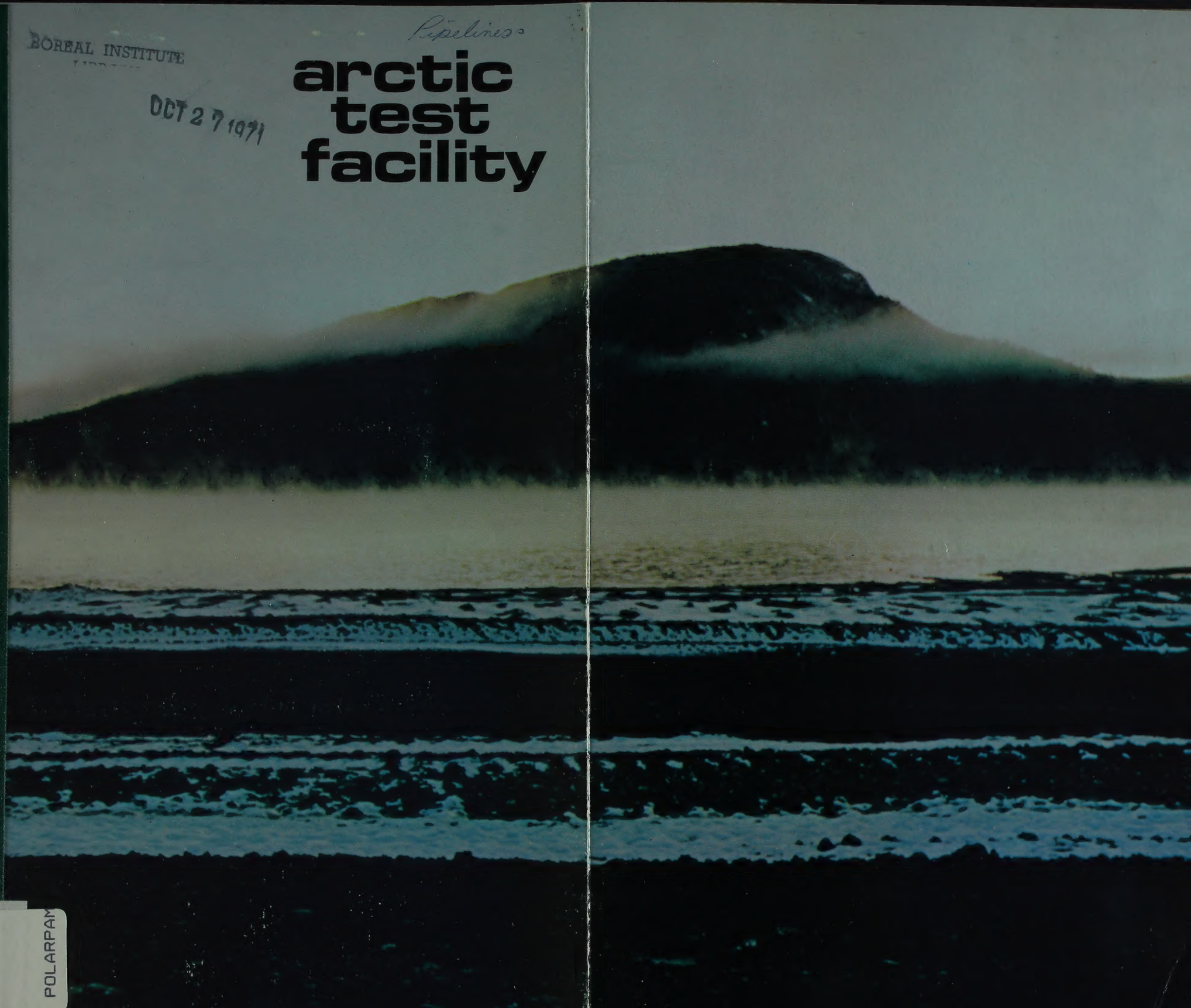
Pipelines

arctic test facility



arctic pipeline challenge

How do you build and operate a large natural gas pipeline through the Arctic without damage to the permafrost?

Permafrost, or permanently frozen ground, is the bedrock of the Arctic. It varies in thickness from a few feet to 2,000 feet, and may consist of rock, gravel, sand, silt and other soils. Ground ice content may range from zero to 80 percent. Ice lenses are numerous, some measuring up to 20 feet or more in thickness and covering areas as great as two or three city blocks.

To permit the permafrost to thaw can cause environmental damage.

A major part of the solution may be to bury the pipeline and to chill the gas at the discharge of each compressor station to a temperature very close to that of the soil in which the pipe is laid.

To confirm the feasibility of this, the Northwest Project Study Group has committed $3.5 million to an experimental pipeline project to simulate operating conditions in an actual Arctic gas pipeline transmission system. This is the Arctic Test Facility, located on the west bank of the Mackenzie River at its junction with the Mountain River, between Fort Good Hope and Norman Wells.

the northwest project

The Arctic Test Facility at Mountain River is just one phase of the research of the Northwest Project Study Group.

The Group has been engaged since 1969 in joint research and feasibility studies to determine the associated problems and solutions related to the construction and operation of a large diameter natural gas transmission system from the North Slope of Alaska and northern Canada to markets in the United States midwest and eastern Canada. More than $12 million have been committed to these studies.

The studies to date indicate that the ultimate pipeline would be almost 2,500 miles in length; involve pipeline sizes up to, and possibly beyond, 48 inches in diameter; transport approximately three billion cubic feet of gas per day when fully powered by 50 compressor stations; and cost about $2.5 billion to construct. The pipeline would extend from the North Slope of Alaska, across Canada to the United States border at a point near Emerson, Manitoba, where it would connect with other pipelines supplying markets in eastern Canada and the United States midwest region.

Participants in the Study Group are three producers of oil and gas having interests in reserves on the North Slope of Alaska, and three natural gas pipeline companies seeking additional gas supplies to serve expanding markets in Canada and the midwestern U.S.

arctic test facility

The Arctic Test Facility will, during an extended period, provide data on

- stability of gas pipelines in permafrost under various simulated operating conditions;
- stability of different types of foundations for above-ground structures;
- effects of a pipeline on various forms of surface cover;
- drainage problems associated with Arctic pipeline construction;
- construction methods, materials and equipment for use in an ultimate pipeline system.

The facility consists of five sections of 48-inch diameter steel pipeline, each 500 feet in length. Four sections are buried in the permafrost, each in a different soil type. The fifth section is partially above ground, mounted on pilings set deep into the frozen soil, and passes through the active layer into permanently frozen, fine, high ice-content silt. The five sections are connected into two separate loops. The "cold loop" contains three buried sections. The "cycling loop" contains a buried section and the partially elevated section.

Each section in each loop is instrumented so that the magnitude and the nature of forces, if any, exerted on the pipe by frost action or other causes can be measured. There are 450 strain measurement points, and 550 temperature sensors installed on and around the pipe.

Compressor units and heating and refrigeration equipment are connected in such a way that the temperature in each section can be controlled independently of all other sections.

Compressed air, chilled to a temperature range of zero to 30 degrees F., is used in the cold loop to simulate the flow of natural gas. The cycling loop tests the effects of alternately cycling hot and cold air to simulate the loss of a refrigeration unit at a main line compressor station.

Six inactive sections of 42-inch diameter pipe have been installed underground at selected locations around the site.

The pipe ditches were dug seven to nine feet deep, with a width of 60 inches.

The test site was selected to meet critical requirements: concentration of a variety of different soil types in a relatively small area; an adequately thick "active zone" (the surface layer which thaws in the short, warm summer); availability of substantial quantities of gravel where extraction would not harm fish life; reasonable convenient access for delivery of equipment and material.

Permafrost in this area is about 300 feet deep.

multi-phase studies

Other phases of the research and feasibility studies being conducted by the Northwest Project Study Group, include:

- Project Geomet, involving temperature measurements at ground surface and subsurface depths to 20 feet, at 10 locations along prospective pipeline routes.
- Terrain studies, involving aerial photography interpretation from black-and-white, color and infrared.
- Route selection studies to determine most favorable pipeline routes, with minimum ecological and environmental effects.
- Extensive ecological studies, including environmental factors and wildlife conservation.
- Pipeline design studies to determine optimum variable factors

such as line diameter, pressures, and spacing of compressor stations.
- Study of present and potential gas reserves on the North Slope of Alaska, the Northwest and Yukon Territories, and areas in British Columbia, Alberta, Saskatchewan and Manitoba in the vicinity of a possible pipeline route.
- Financing and economic feasibility studies.

Williams Brothers Canada Limited, of Calgary, Alberta, as the NPSG consulting engineers, is directing the technical research program, including the construction and maintenance of test facilities.

Consultants and outside experts engaged in the Group's studies include:

Canadian Pacific Consulting Services Ltd., Montreal; DeGolyer & MacNaughton, Dallas, Texas; Morgan, Stanley & Company, New York; Dillon, Read & Co. Inc., New York; Nesbitt, Thomson & Co. Limited, Montreal; Muskeg Research Institute, University of New Brunswick, Fredricton; Metallurgical Consultants Inc., Houston, Texas; C. E. Makepeace, Ottawa; J. D. Mollard and Associates Limited, Regina, Sask.; R. M. Hardy & Associates Ltd., Edmonton, Alberta; Dr. R. G. H. Cormack, Edmonton; Dr. D. L. Katz, University of Michigan, Ann Arbor, Michigan; Dr. D. M. Coulter, Royal Military College, Kingston, Ontario; Renewable Resources Consulting Services Ltd., Edmonton; A. F. Oeming, Alberta Game Farm, Ardrossan, Alberta; Dr. Frank Banfield, Brock University, St. Catherines, Ontario; Dr. Peter J. McCart, University of Calgary; Environmental Research Associates, Toronto, Ontario; Dr. Stanley Rowe, University of Saskatchewan, Saskatoon.

test site facilities

Facilities at the Arctic Test Site include electric power generators, storage for a full year of fuel supply, fabrication buildings, and a permanent camp.

The camp provides modern, comfortable accommodation and recreational facilities, for up to 40 men. It is supplied with electric power, a central heating system and water which is filtered and chlorinated.

Sleeping quarters, wash rooms, offices and cooking and dining quarters are each contained in separate units which are inter-connected by closed-in passages.

Sewage is carried in a utilidor to a modern treating plant, where it is processed to eliminate any risk of pollution by the effluent.

Offices:
Northwest Project Study Group.
1270 Calgary House, 550-6th Ave. S.W.
Calgary 1, Alberta.
Telephone (403) 266-6201
TWX NPSG 610 821 0494
Project Manager: Lee G. Hurd
Public Affairs: Earle Gray

Consulting Engineers:
Williams Brothers Canada Limited.
Third Floor, 640-7th Ave. S.W.
Calgary 1, Alberta.
Telephone (403) 266-8601
Executive Vice President: P. H. Dau

northwest project study group

Atlantic Richfield Company
Humble Oil & Refining Company
The Standard Oil Company (Ohio)
TransCanada PipeLines Limited
Michigan Wisconsin Pipe Line Company
Natural Gas Pipeline Company of America